Oral Remarks
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on

Mercury Controls for Power Plants

before the

House Committee on Science's
Subcommittee on Environment, Technology, and Standards
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Mr. Chairman and Members of the Subcommittee:

Thank you for inviting EPRI to address the House Committee on Science's Subcommittee on Environment, Technology, and Standards on the important subject of mercury reductions from power plants. I am George Offen, and I manage our programs in air emission reductions and the beneficial use of combustion products. EPRI was established 30 years ago as a non-profit, collaborative R&D organization to carry out electricity-related supply, delivery, end-use, and environmental R&D in the public interest. Our funders include electric power companies responsible for over 90% of the electricity sold in the US, as well as over 60 companies worldwide. We also cooperate closely with (and for some projects receive funding from) government agencies in our research programs, particularly DOE and EPA, as well as equipment suppliers and engineering firms. This is especially true in the case of mercury.

For well over a decade, EPRI has been conducting research on all aspects of mercury– sources, movement and chemical transformation in the environment, health effects, and methods to reduce emissions. My remarks today will respond to five questions in three topical areas that this Subcommittee asked EPRI to address on the subject of mercury control technologies.

1. <u>Existing controls</u>

   A. <u>To what extent do control technologies *in use* today at utilities reduce mercury pollution?</u>

On average across the domestic coal-fired population of power plants, current technologies used to reduce particulate, NO_x, and SO_2 emissions capture about 40% of the mercury that enters these boilers with the coal. However, these removals vary from less than 10% to over 90%, depending on the coal and air pollution controls used. Further, the data that underlie these generalizations are snapshots in time at each plant – in many cases just a few tests over a 1-2 day period – while we now know that emissions can vary by a factor of 5 or more over a week's period. I should note that the removal efficiencies cited above are additive to the mercury removed by coal washing for the many supplies of eastern bituminous coal that are washed; cleaning these coals often provides an average mercury reduction of 25-35% before the coal arrives at the power plant.

B. What determines the effectiveness of these technologies in reducing mercury emissions?

The primary factors that affect the capture of mercury by existing air pollution controls are the coal burned and the type of air pollution (NO_x, SO_2, particulate) controls used at the plant. Mercury in the flue gas appears as a mix of elemental (or metallic, non-water soluble) and oxidized (water soluble) mercury, depending primarily on the coal and to a lesser extent on the design of the boiler. Some controls, such as scrubbers for SO_2 reduction, capture only oxidized mercury. In some cases, selective catalytic reduction (SCR) for NO_x control may increase the percent of the mercury that is in the oxidized form, enabling a downstream scrubber (if present at the power plant) to capture more of the mercury. Coals and boilers that result in increased levels of carbon leaving the boiler unburned tend to produce a fly ash that may adsorb some of the mercury. The amount that would be adsorbed and subsequently captured by the particulate control depends on the technology used – electrostatic precipitators or baghouses – due to the difference in how the fly ash and flue gases contact each other in these devices. All these interactions depend on complex chemical reactions between various species in the flue gas, especially chlorine, but we do not yet totally understand this chemistry.

2. New controls

A. What are the major technologies *under development* today to control mercury emissions from power plants?

The technical community is following four parallel paths to seek cost-effective, sustainable mercury controls for the domestic boiler population – (1) trying to understand and improve the performance of existing controls, especially the combination of SCR and scrubbers; (2) developing and lowering the cost of sorbent injection (such as activated carbon), the nearest-term mercury-specific technology; (3) developing and demonstrating new technologies; and (4) developing multi-pollutant controls to capture NO_x, SO_2, mercury, and particulate in an integrated fashion. With sorbent injection, a powder such as activated carbon is injected into the flue gas ahead of the particulate collector, where it captures the mercury by adsorption and is then, itself, collected along with the fly ash in the particulate collector. The technical community is looking at variants of this process aimed at reducing costs, avoiding contamination of the ash by using non-carbon sorbents, and developing sorbents that work for all coals and particulate/SO_2 controls. New technologies include catalysts designed specifically to oxidize mercury that would be placed at the clean end of the particulate collector for plants with downstream SO_2 control; attempts to make flue gas from Powder River Basin and other low-chlorine western coals behave like Eastern bituminous coal by adding chemicals to the coal or boiler; and fixed structures that sit in the flue gas ducts and adsorb mercury until they need to be regenerated.

B. What do full-scale demonstrations tell us about the likely costs and effectiveness of these technologies?

To date we only have full-scale data on activated carbon injection, and those data are limited to one week tests at just one site for each of the coals tested. Mercury removals were different at each of the sites (see Figure, which also shows the broad range of pilot-scale results), and we do not know if this was due to the different fuels or other reasons. The short-term removals ranged from a maximum of 60-70% at the site burning Powder River Basin coal to as much as 90% at the plant firing Eastern low-sulfur bituminous coal site. Because these tests were demonstrations, we do not have commercial cost data for the installations. Furthermore, having no long-term operational experience with these systems, we know neither their ability to sustain these levels of performance nor their potential impacts on plant operations and maintenance. Assuming sustainable operation and no unexpected impacts – both big assumptions at this point in time – we have estimated costs of $2 MWh to $3 MWh for activated carbon injection, including sorbent, operation and maintenance, and amortized capital.

3. What are the major barriers to development of technologies to control mercury emissions from power plants?

The biggest barrier is the complexity of mercury chemistry in flue gases, and the underlying lack of fundamental data on the chemical reactions in this kind of environment. This prevents us from (1) extrapolating tests on one power plant to other plants with apparently similar features, and (2) carrying out most of the development of new technologies in the lab, where the costs should be less and turnaround time quicker. Consequently, most of our development work occurs via full-scale trials at power plants, and we need data from enough plants to allow us to develop correlations we can use to predict mercury control performance across the population of U.S. boilers. The other main barrier is the absence of any long-term experience with mercury controls to address the questions I have raised on sustainable operation and potential impacts on boiler operation and maintenance.

DOE's Phase II field test program, which EPRI strongly supports, is an important step to address both these needs. We believe that additional tests, possibly of shorter duration, are still needed to provide greater confidence in the representativeness of the data we will obtain under the DOE Phase II program, and they are needed on an accelerated schedule so that the power companies can use the results to meet their upcoming regulatory obligations. We would also recommend that DOE conduct similar field test evaluations of integrated pollution controls for those that show promise at smaller scale.

Summary

Over the past decade, the technical community has made substantial progress in understanding mercury emissions and developing mercury reduction options for a wide range of coals and power plant air pollution control configurations. Coal washing and existing emission controls already reduce some of the mercury emitted from coal-fired power plants, although this varies widely. The ability to remove mercury from power plant flue gas is determined largely by the coal properties - especially chlorine content and coal reactivity – the degree to which the boiler can combust the coal completely, and the controls in existence at each individual plant. Correspondingly, suppliers, DOE, EPRI, and others are developing a variety of mercury controls to provide cost-effective solutions for these various fuel/equipment configurations. Accelerated research on mercury flue gas chemistry in parallel with expansion of the current DOE field test program are needed to determine performance and cost with confidence.

Thank you, again, for giving EPRI the opportunity to provide these comments.

Field Results – ACI Hg Removal w/ ESPs

-Which line is correct?
-Is each unique or representative of a category?